

Claims

1. A coating composition comprising

a1) a physically drying film forming binder resin or resins;

5 a2) a thermally cross linking film forming binder resin or binder resins;

a3) a radiation curable film forming binder resin or binder resins;

a4) an autoxidatively drying film forming binder resin or resins; or

a5) a combination of binder resins with at least two different crosslinking mechanisms selected from a1), a2), a3) or a4);

10

b) a polymer or copolymer levelling agent of formula (I) $\text{In}-[(\text{M})_x(\text{E})_y]_n$ (I) obtained by nitroxyl mediated controlled free radical polymerisation wherein

In is the initiator fragment starting the polymerisation reaction;

15 M is at least one monomer selected from the group consisting of acrylic acid, methacrylic acid, acrylic acid (C₁-C₂₂)alkyl esters, acrylic acid (C₁-C₂₂)hydroxyalkyl esters, methacrylic acid (C₁-C₂₂)alkyl esters, methacrylic acid (C₁-C₂₂)hydroxyalkyl esters, acrylic acid (C₁-C₂₂)alkyl esters or methacrylic acid (C₁-C₂₂)alkyl esters which are substituted by amino, (C₁-C₂₂)alkylamino, (C₁-C₂₂)dialkylamino, -SO₃H, epoxy, fluoro, perfluoro or siloxane groups, 20 styrene, substituted styrene, acrylamide and methacrylamide, N-mono(C₁-C₂₂)alkyl acrylamide, N,N-di(C₁-C₂₂)alkyl acrylamide, and a multifunctional monomer with two or more ethylenically unsaturated bonds;

provided that the amount of unsubstituted acrylic acid (C₁-C₂₂)alkyl esters or/and methacrylic acid (C₁-C₂₂)alkyl esters is more than 30 % by weight based on the weight of the total 25 monomer mixture;

E is a group bearing at least one stable free nitroxyl radical, which is bound via the oxygen atom to the polymer or copolymer; or a group which results from a substitution or elimination reaction of the attached stable free nitroxyl radical;

x is the total number of monomer units, which is a number between 5 and 5000;

30 y is a number 1 or greater than 1 indicating the average number of end groups E attached to the monomer sequence (M)_x;

n is a number from 1 to 20; and

c) optionally water or/and one or more organic solvents.

- 64 -

2. A coating composition according to claim 1 comprising
 a2) a thermally cross linking film forming binder resin or binder resins; or
 a3) a radiation curable film forming binder resin or binder resins.

- 5 3. A coating composition according to claim 1 comprising
 a2) a thermally cross linking film forming binder resin or binder resins.

4. A coating composition according to claim 1 comprising
 a2) a thermally cross linking film forming binder resin or binder resins without water and
 10 organic solvent, which is in the form of a solid powder.

5. A coating composition according to claim 1 wherein the polymer or copolymer levelling agent of formula (I), is obtained by

b1) polymerization in the presence of an alkoxyamine initiator/regulator having the structural

- 15 element $\begin{array}{c} \diagup \\ \text{N}-\text{O}-\text{X} \\ \diagdown \end{array}$; or by

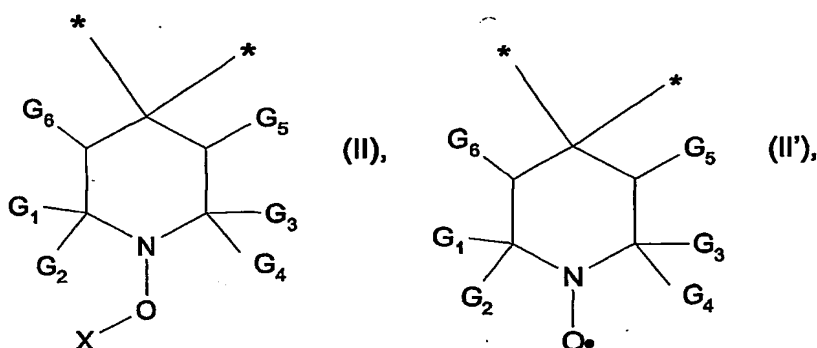
b2) polymerization in the presence of a stable nitroxyl free radical having the structural

element $\begin{array}{c} \diagup \\ \text{N}-\text{O}\cdot \\ \diagdown \end{array}$ and a radical initiator.

6. A coating composition according to claim 5 wherein the structural element $\begin{array}{c} \diagup \\ \text{N}-\text{O}-\text{X} \\ \diagdown \end{array}$

- 20 is a structural element of formula (II) and the structural element $\begin{array}{c} \diagup \\ \text{N}-\text{O}\cdot \\ \diagdown \end{array}$ is a structural element of formula (II')

- 65 -



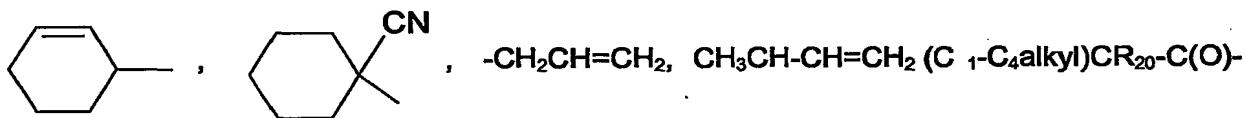
wherein

G_1, G_2, G_3, G_4 are independently C_1 - C_6 alkyl or G_1 and G_2 or G_3 and G_4 , or G_1 and G_2 and G_3 and G_4 together form a C_5 - C_{12} cycloalkyl group;

5 G_5, G_6 independently are H, C_1 - C_{18} alkyl, phenyl, naphthyl or a group $COOC_1$ - C_{18} alkyl;

X is selected from the group consisting of

$-CH_2$ -phenyl, CH_3CH -phenyl, $(CH_3)_2C$ -phenyl, $(C_5$ - C_6 cycloalkyl) $_2CCN$, $(CH_3)_2CCN$,

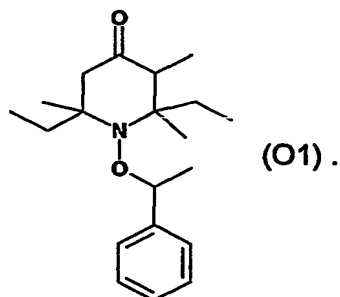


10 phenyl, $(C_1$ - C_4)alkyl- CR_{20} -C(O)-(C₁-C₄)alkoxy, $(C_1$ - C_4)alkyl- CR_{20} -C(O)-(C₁-C₄)alkyl, $(C_1$ - C_4)alkyl- CR_{20} -C(O)-N-di(C₁-C₄)alkyl, $(C_1$ - C_4)alkyl- CR_{20} -C(O)-NH(C₁-C₄)alkyl, $(C_1$ - C_4)alkyl- CR_{20} -C(O)-NH₂, wherein

R_{20} is hydrogen or $(C_1$ - C_4)alkyl and

* denotes a valence.

15 7. A coating composition according to claim 6 wherein the structural element of formula (II) is a compound of formula (O1)



8. A coating composition according to claim 1 wherein the levelling agent, component b), has a polydispersity of between 1.0 and 2.0.

9. A coating composition according to claim 1 wherein the levelling agent, component b), has a glass transition temperature between 20° C and 200° C.

5 10. A coating composition according to claim 1 wherein the levelling agent, component b), is composed of at least 30 % by weight of tert.-butylacrylate and/or tert.-butylmethacrylate, based on the weight of total monomers.

10 11. A coating composition according to claim 1 wherein the levelling agent, component b), is a linear polymer or copolymer, i.e. in formula (I) n is 1.

12. A coating composition according to claim 1 wherein in formula (I), component b), y is 1.

15 13. A coating composition according to claim 1 wherein the levelling agent, component b), has a molecular weight of between 3000 to 50000 g/mol (Dalton).

20 14. A coating composition according to claim 1 wherein the levelling agent, component b), is composed of at least 30 % by weight of tert.-butylacrylate and/or tert.-butylmethacrylate, and 0.5 to 50 % of a functional monomer which is selected from the group consisting of acrylic acid, methacrylic acid, acrylic acid (C₁-C₆)hydroxyalkyl esters, methacrylic acid (C₁-C₆)hydroxyalkyl esters, acrylic acid (C₁-C₆)alkyl esters and methacrylic acid (C₁-C₆)alkyl esters which are substituted by amino, (C₁-C₆)alkylamino, (C₁-C₆)dialkylamino, epoxy, fluoro, perfluoro or siloxane groups.

25 15. A coating composition according to claim 1 wherein the levelling agent, component b), is composed of at least 50 % by weight of tert.-butylacrylate and/or tert.-butylmethacrylate and is a solid at room temperature.

30 16. A coating composition according to claim 1 wherein the levelling agent, component b), is present in an amount of 0.1 to 15% by weight, based on the weight of the film forming binder resin or resins, component a).

17. A process for improving the levelling of a coating composition according to claim 1, which process comprises the steps

applying the coating composition to a substrate and exposing it to thermal energy or electromagnetic radiation in order to obtain a homogenous solid coating.

18. Use of a polymer or copolymer of formula (I), $\text{In}-[(\text{M})_x(\text{E})_y]_n$ (I) obtained by nitroxyl mediated controlled free radical polymerisation wherein

In is the initiator fragment starting the polymerisation reaction;

M is at least one monomer selected from the group consisting of acrylic acid, methacrylic acid, acrylic acid (C₁-C₂₂)alkyl esters, acrylic acid (C₁-C₂₂)hydroxyalkyl esters, methacrylic acid (C₁-C₂₂)alkyl esters, methacrylic acid (C₁-C₂₂)hydroxyalkyl esters, acrylic acid (C₁-C₂₂)alkyl esters or methacrylic acid (C₁-C₂₂)alkyl esters which are substituted by amino, (C₁-C₂₂)alkylamino, (C₁-C₂₂)dialkylamino, -SO₃H, epoxy, fluoro, perfluoro or siloxane groups, styrene, substituted styrene, acrylamide and methacrylamide, N-mono(C₁-C₂₂)alkyl acrylamide, N,N-di(C₁-C₂₂)alkyl acrylamide, and a multifunctional monomer with two or more ethylenically unsaturated bonds;

provided that the amount of unsubstituted acrylic acid (C₁-C₂₂)alkyl esters or/and methacrylic acid (C₁-C₂₂)alkyl esters is more than 30 % by weight based on the weight of the total monomer mixture;

E is a group bearing at least one stable free nitroxyl radical, which is bound via the oxygen atom to the polymer or copolymer; or a group, which results from a substitution or elimination reaction of the attached stable free nitroxyl radical;

x is the total number of monomer units, which is a number between 5 and 5000;

y is a number 1 or greater than 1 indicating the average number of end groups E attached to the monomer sequence (M)_x;

n is a number from 1 to 20;

as a levelling agent for a coating composition comprising

a1) a physically drying film forming binder resin or resins;

a2) a thermally cross linking film forming binder resin or binder resins;

a3) a radiation curable film forming binder resin or binder resins;

a4) an autoxidatively drying film forming binder resin or resins; or

a5) a combination of binder resins with at least two different crosslinking mechanisms selected from a1), a2), a3) or a4).

- 68 -

19. A coating composition comprising

- a1) a physically drying film forming binder resin or resins;
- a2) a thermally cross linking film forming binder resin or binder resins;
- a3) a radiation curable film forming binder resin or binder resins;
- 5 a4) an autoxidatively drying film forming binder resin or resins; or
- a5) a combination of binder resins with at least two different crosslinking mechanisms selected from a1), a2), a3) or a4);

b) a polymer or copolymer levelling agent of formula (X), prepared by atom transfer radical polymerisation
$$\text{In}-[(\text{M})_x-(\text{E})_y]_n \quad (\text{X})$$

wherein

In is the initiator fragment starting the polymerisation reaction;

M is at least one monomer selected from the group consisting of acrylic acid, methacrylic acid, acrylic acid (C₁-C₂₂)alkyl esters, acrylic acid (C₁-C₂₂)hydroxyalkyl esters, methacrylic acid (C₁-C₂₂)alkyl esters, methacrylic acid (C₁-C₂₂)hydroxyalkyl esters, acrylic acid (C₁-C₂₂)alkyl esters or methacrylic acid (C₁-C₂₂)alkyl esters which are substituted by amino, (C₁-C₂₂)alkylamino, (C₁-C₂₂)dialkylamino, -SO₃H, epoxy, fluoro, perfluoro or siloxane groups, styrene, substituted styrene, acrylamide and methacrylamide, N-mono(C₁-C₂₂)alkyl acrylamide, N,N-di(C₁-C₂₂)alkyl acrylamide, and a multifunctional monomer with two or more ethylenically unsaturated bonds;

with the proviso that the amount of tert.-butylacrylate is more than 30 % by weight, based on the weight of the total monomer mixture;

E is Cl, Br or a group introduced by nucleophilic substitution of Cl or Br;

x is the total number of monomer units, which is a number between 5 and 5000;

y is a number 1 or greater than 1 indicating the average number of end groups E attached to the monomer sequence (M)_x;

n is a number from 1 to 20; and

c) optionally water or/and one or more organic solvents.

20. Use of poly-tert.-butyl acrylate or poly-tert.butylmethacrylate as a levelling agent in powder coating compositions.